Species composition and classification of natural vegetation in the abandoned lands of the hilly-gullied region of North Shaanxi Province

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1. Abstract

Based on the survey of 174 samples of natural vegetation in Yan'an, An'sai and Wuqi in the abandoned lands in the hilly-gullied region of the North Shaanxi Province, the floristic elements, areal-types, life forms and ecological types of species, frequency and cover of species, and vegetation types and succession direction were analyzed. The results indicate that under the current environmental condition the restoration of shrub and tree species on a large scale on the hilly-gullied Loess Plateau is not appropriate.

2. Introduction

Although vegetation restoration has implemented more than 50 years in the Loess Plateau region of China, the deterioration of eco-environmental situation has not been effectively controlled, and erosion and sediment yield still threaten lower reaches of the Yellow River. In addition, artificial vegetations predatorily utilizing limited soil water resources leads to obvious soil dry layer, which influences sustainable development of ecosystem (Mu et al. 2003; Li 2001). There are many reasons for this noneffective vegetation restoration，but not following ecological principle is one of important reasons (Jing & Zheng 2004; Zou et al. 1995), because plant ecological characteristics is the result of a species adapting to a certain or a group important environmental factors for a long term (Li & Yang 2002). Therefore, the species composition structure and community types of existing natural vegetation in different environmental conditions have important realistic guiding significance for accelerating and regulating vegetation succession to an ideal goal. However, no comprehensive analysis of floristic composition, ecological characteristics and vegetation types of natural restoration vegetation in the abandoned lands in the Loess Plateau region has conducted. Thus the paper will aim at this to provide references for proper artificial intervention to accelerate vegetation restoration progress and evaluating vegetation restoration potential in the hilly-gullied region of the North Shaanxi Province.

3. Methods

Natural vegetation in Yan'an, An'sai and Wuqi in the abandoned lands in the hilly-gullied region of the North Shaanxi Province was surveyed with 174 sampling plots by recording the frequency and cover of species, and the floristic elements, areal-types, life forms and ecological types of species were counted. The vegetation type was classified using Two Way Indicator Species Analysis (TWINSPAN), six cut levels were used producing up to six pseudospecies per species: 0.1-4%, 4.1-10%, 10.1-25%, 25.1-33%, 33.1-50% and 50.1% or greater (Rodwell 1991), and the weights for the 6 levels of pseudospecies were 1, 1, 2, 2, 3 and 3 in the analysis.

4. Results

4.1 Composition structure of species

132 species were recorded in abandoned croplands from 174 sampled plots, which belonged to 102 genera and 48 families. Genera and species belonging to gramineae, compositae, leguminosae and rosaceae occupied 45.1% and 54.5% of total genera and species separately. There were 13 area-types and 11 subtypes of genera, in which the percent of genera belonging to north temperate, cosmopolitan, old world temperate and pantropic occupied 70.6% of total genera and 74.3% of total species separately. Most species belonging to north temperate and old world temperate were the dominant species and main company species, while most of the species belonging to cosmopolitan and pantropic had higher frequency, but exist sparsely in sample plots. The growth form, life form and water ecological type structures of the vegetation are shown in Table 1.

Table 1 The statistics of ecological components of the flora

Growth form		Num.	Ratio %	Water ecological type	Num.	Ratio %	Life form	Num.	Ratio %
Arbor		11	8.3	Strong-xerophytic	3	2.3	Phaenerophyte	22	16.7
	Shrub	10	7.6	Xerophytic	31	23.5	Chamaerhyte	20	15.2
Shrub group	Semi-shrub	9	6.8	Xerophytic-mesophytic	49	37.1	Hemicryphtophyte	55	41.7
	small-shrub	5	3.8	Mesophytic	46	34.8	Geocryphtophyte	11	8.3
	Annual	22	16.7	Hygromorphic	3	2.3	Therophytes	24	18.2
Herbage groups	Biennial	6	4.5						
	Perennial	68	51.5						

4.2 Frequency and coverage of species

There were only 6 species with frequency >50%, namely *Lespedeza davurica*, *Heteropappus altaicus*, *Stipa bungeana*, *Artemisia scoparia*, *Artemisia gmelinii* and *Astragalus scaberrimus*, and the first 5 species more than 70%, the number of species with frequency >25% was 22 and occupied 16.7% of total species; There were more species with occurrence frequency >50% and >70% in single sample plot and the number was 82 and 54 separately. While there were 23 species with coverage >25% and only 14 species with coverage >50% in single sample plot, occupied 17.4% and 10.6% of total species separately; and the number of species with average coverage >5% and 10% was occupied 20.5% and 14.4% separately.

The results indicated there were few species with high frequency and coverage during natural vegetation restoration in the area. Only *Lespedeza davurica*, *Heteropappus altaicus*, *Stipa bungeana*, *Artemisia scoparia*, *Artemisia gmelinii*, *Leymus scalinus*, *Artemisia giraldii* and *Bothriochloa ischaemun* had high frequency and coverage. The later successional species, such as *Syringa julianae*, *Sophora viciifolia*, *Rosa xanthina*, *Cotoneaster multiflorus*, *Platycladus orientalis*, *Ostryopsis daridiana*, *Hippophae rhamnoides* and *Quercus liaotungensis*, having higher coverage but low frequency in the sample plots, were not the main vegetation types in the hilly-gullied region of the North Shaanxi Province.

4.3 Vegetation classification and succession direction

Based on the TWINSPAN results of plots in both sunny and shady slopes of Yan'an, An'sai and Wuqi (Figure 1), it could be concluded that in the earlier stages of succession from annual herbs to perennial herbs, the dominant species are *Artemisia scoparia*, *Leymus secalinus*, *Lespedeza davurica*, *Stipa bungeana*, *Artemisia gmelinii*, *Artemisia giraldii* and *Bothriochloa ischaemun*, and consist of the main plant communities with

different combinations of these species. However, in the later stages of succession the vegetation of different zones and slopes changes significantly, in the forest zone represented in Yan'an area, the vegetation of the shady slopes could be *Rosa xanthina*, *Acer buergerianum*, *Quercus liaotungensis,* dominated communities, and the vegetation of the sunny slopes could be *Sophora viciifolia* and *Platycladus orientalis* dominated communities. In the forest-steppe zone in the An'sai area, the vegetation of the shady slopes could be *Rosa xanthina*, *Syringa julianae*, and *Ostryopsis davidiana* dominated communities, and the vegetation of the shady slopes could be *Bothriochloa ischaemun* and *Sophora viciifolia* dominated communities; but no second forest existed both in shady and sunny slopes, although *Pyrus betulaefolia* occasionally appeared in Zhifanggou watershed of Ansai, it had obvious characteristics of shrub, however it could grow to a high tree in Yangou watershed of Yan'an. In the steppe zone represented in Wuqi area, the variation of vegetation both in the sunny and shady slopes is not obvious, and the main vegetation is perennial herbs dominated by *Lespedeza davurica*, *Stipa bungeana*, *Artemisia gmelinii*, *Artemisia giraldii*, and zonal species e.g. *Thymus mongolicus*, *Potentilla acaulis*, *Artemisia frigida* appeared. The shrub and tree species in the later stages had higher cover but occured only sporadically. The landscape of mosaic existence of annual herbage community and perennial Artemisia-Gramineae herbage community and the scattered distribution of later succession species had a close relationship with fragmentary terrain, modern high reclamation rate and cultivation mode of small field patch.

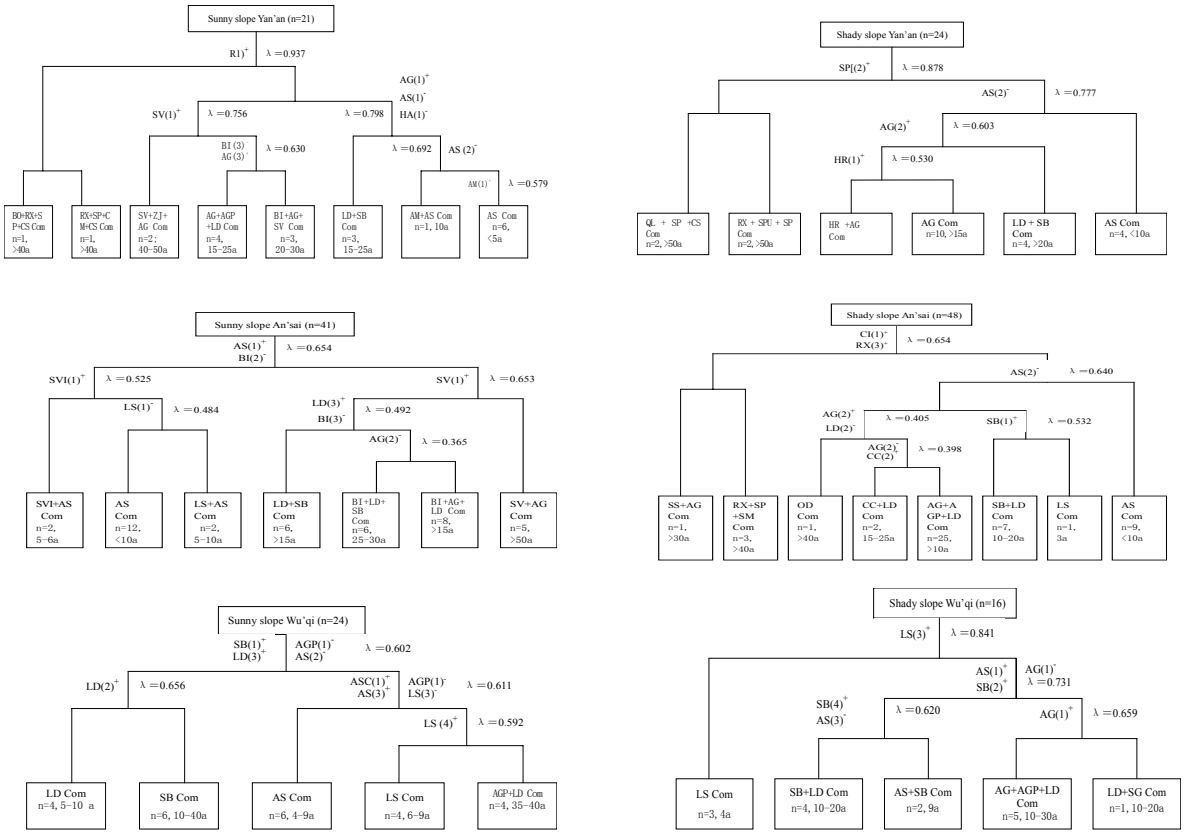

Figure 1 Dendrogram of the TWINSPAN classification of vegetation types on abandoned cropland

λ means Eigenvalue; + represents for positive indicator species; - represents for negative indicator species; the number in ( ) is cut level; n is the number of plots; and a is the years since abandonment; AG= *Artemisia gmelinii*; AGP=*Artemisia giraldii;* AM= *Astragalus melitoloides;* AS= *Artemisia scoparia*; ASC= *Astragalus scaberrimus*; BI= *Bothriochloa ischaemun*; BO= *Platycladus orientalis*; CC= *Cleistogenes caespitosa*; CI=*Caragana intermedia;* CM=*Cotoneaster multiflorus;* CS= *Carex lancifolia*; HA=*Heteropappus altaicus;* HR=*Hippophae rhamnoides;* LS=*Leymus secalinus;* LD=*Lespedeza davurica*; OD=*Ostryopsis davidiana;* QL=*Quercus liaotungensis;* RX=*Rosa xanthina;*SV=*Sophora viciifolia;* SP=*Syringa julianae;* SB= *Stipa bungeana*; SG= *Stipa grandis;* SPU=*Spiraea pubescens;* SVI=*Setaria viridis;* SS=*Selaginella sinensis;* ZJ=*Ziziphus spinosa.*

The research showed that vegetation in the area had the potential recovering to forest-steppe vegetation including southern forest vegetation and northwestern steppe vegetation under the present climate condition, but it was also difficult for recovering to later communities for the restriction of soil condition (Jiao et al. 2005) and propagule deficiency of later species (Bai et al. 2007). It was confirmed by the vegetation construction practices, afforestation never stops on the Loess Plateau since 1949, but less than 10% of afforestation area is considered to have higher coverage (Tian 2003); Furthermore, artificial forest consumed more soil water and forms soil dry layer (Mu et al. 2003) which resulted in potential danger to bald hills (Hou et al. 1999). Above all, it was not under the environment condition for the restoration of shrub and arbor in a large scale on the hilly-gullied Loess Plateau nowadays, especially in the area north of Yan'an. Therefore, the vegetation restoration should take the existing vegetation status as a reference, and the mass tree planting with pits on the Loess Plateau region should be deliberated.

5. References

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